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Original Article

Burden of Household Environmental Tobacco Smoke on Medical Expenditure for Japanese Women: A Population-Based Cohort Study

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ABSTRACT

Background: The economic consequences of environmental tobacco smoke (ETS) have been simulated using models. We examined the individual-level association between ETS exposure and medical costs among Japanese nonsmoking women.

Methods: This population-based cohort study enrolled women aged 40 to 79 years living in a rural community. ETS exposure in homes at baseline was assessed with a self-administered questionnaire. We then collected health insurance claims data on direct medical expenditures from 1995 through 2007. Using generalized linear models with interaction between ETS exposure level and age stratum, average total monthly expenditure (inpatient plus outpatient care) per capita for nonsmoking women highly exposed and moderately exposed to ETS were compared with expenditures for unexposed women. We performed separate analyses for survivors and nonsurvivors.

Results: We analyzed data from 4870 women. After adjustment for potential confounding factors, survivors aged 70 to 79 who were highly exposed to ETS incurred higher expenditures than those who were not exposed. We found no significant difference in expenditures between moderately exposed and unexposed women. Total expenditures were not significantly associated with ETS exposure among survivors aged 40 to 69 or nonsurvivors of any age stratum.

Conclusions: We calculated individual-level excess medical expenditures attributable to household exposure to ETS among surviving older women. The findings provide direct evidence of the economic burden of ETS, which is helpful for policymakers who seek to achieve the economically attractive goal of eliminating ETS.

Key words: secondhand smoke; tobacco smoke pollution; longitudinal study; environment and public health; health care costs

INTRODUCTION

Exposure to environmental tobacco smoke (ETS), also known as secondhand smoke, passive smoking, and involuntary smoking, is a risk factor for mortality[1,2] and morbidity from many diseases, including lung cancer[3,4] and coronary heart disease.[5,6] ETS exposure accounts for 11% of all tobacco-related deaths.[7] Öberg et al[8] reported that 1.0% of worldwide mortality is attributable to ETS. Public health concern is therefore elevated because diseases attributable to ETS are occurring among nonsmokers, and the resulting increase in mortality and morbidity is involuntary.

Medical expenditures are higher for active smokers than for nonsmokers,[9–15] and ETS is a risk factor for many of the same diseases caused by active smoking.[3–6] These facts naturally lead us to question whether ETS increases medical expenditures. Little is known, however, of the relationship between ETS exposure and medical expenditures among adults. Previous studies estimated the economic burden attributable to ETS by combining ETS-attributable incidence of diseases and medical costs associated with those diseases.[16–21] The results were obtained from simulations using economic models and did not necessarily reflect the real world.

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Japanese women have the highest ETS exposure among the 7 major industrialized nations.[22] The World Health Organization (WHO) has calculated that 49% to 62% of Japanese women are exposed to ETS.[22] WHO also reported that 42% of Japanese men smoked in 2006, which was the highest rate among the 7 nations. However, the prevalence of smoking among Japanese women was 13% in 2006—the lowest among the 7 nations.

We used individual-level observations of a single cohort of Japanese women to examine differences in direct medical expenditure among nonsmokers and those highly exposed, moderately exposed, and not exposed to ETS.

METHODS

Study design and setting

We used a prospective cohort design. The data were derived from the Ohsaki Cohort Study, the details of which have been reported elsewhere.[23] In brief, this study started in 1994. We conducted a questionnaire survey of National Health Insurance (NHI) beneficiaries aged 40 to 79 years who lived in the catchment area of Ohsaki Public Health Center (Miyagi Prefecture) between October and December 1994. Japan has a universal healthcare system, and the NHI system is operated by local governments, enrolls individuals (eg, farmers, the self-employed, the retired, part-time workers, and their families) not covered by Employees' Health Insurance, and pays for almost all medical services and medications.

This survey used a self-administered questionnaire on various health-related lifestyle factors. Among 54 996 eligible beneficiaries, 52 029 (95%) responded. We prospectively collected claims data (directly from the Miyagi NHI Organizations) on medical expenditures (inpatient and outpatient), insurance status, and survival status for all participants in the cohort during the study period of January 1995 through December 2007. This study was approved by the Ethics Committee of Kyoto University Graduate School of Medicine (Number E1059).

Study population

Among the 52 029 participants in the baseline survey in 1994, we excluded 774 who died or withdrew from NHI before January 1, 1995. Of the 51 255 remaining participants, we selected all female lifelong nonsmokers ($n = 17\,803$), who were identified by the question, "Are you a current smoker, a former smoker, or have never smoked?" All participants who selected the third option were classified as lifelong nonsmokers. We excluded women who provided incomplete information on ETS exposure at home ($n = 634$); those who made a proxy complete the baseline questionnaire (to avoid incorrect assessments made by a proxy; $n = 2081$); those exposed to ETS at work 3 or more days per week ($n = 4538$); those who were divorced or widowed (to avoid underestimating past ETS exposure at home; $n = 1926$); those who had left their job (to avoid underestimating past ETS exposure at work; $n = 3284$); those who died or withdrew in 1995, ie, the first follow-up year (to avoid extremely high or low monthly expenditures; $n = 215$); and those with a history of cancer, myocardial infarction, or stroke ($n = 255$). A total of 4870 women remained for analysis.

Assessment of ETS exposure

We conducted a baseline questionnaire survey of all participants. The item on ETS exposure at home was worded, "How often are you exposed to environmental tobacco smoke at home?" Participants were asked to choose 1 of 5 options: almost every day, 3 to 4 days per week, 1 to 2 days per week, less than once per week, and rarely. For our analyses, we defined household high-level exposure to ETS as the first and second options, moderate-level exposure as the third and fourth options, and no exposure as the fifth option.

Data analysis

With regard to baseline characteristics, differences between the 3 groups were examined using 1-way analysis of variance for duration of follow-up and the chi-square test for the other variables. The Fisher exact test was used when expected cell counts were less than 5.

The primary outcome was total (ie, inpatient plus outpatient care) average monthly medical expenditure per capita, because total expenditures attributable to ETS exposure can be considered to impose an economic burden on society. Total average monthly expenditure for each woman was calculated by dividing the accumulated expenditures through follow-up by number of months observed. A similar approach has been used in the econometric literature to assess medical expenditures related to smoking.[9] In addition to total expenditure, we calculated and compared medical expenditures for inpatient and outpatient care. Outpatient expenditure included costs for drugs dispensed at pharmacies.

ETS exposure can cause fatal diseases, which incur considerable medical expenditures in the terminal phase.[24] Calculating average monthly expenditure incurred by a mixed population of survivors and nonsurvivors creates a bias against the group with the higher mortality risk. Hence, we performed separate analyses for survivors and nonsurvivors.

Cost data are typically skewed to the right. Therefore, generalized linear models with a gamma distribution and log-link function were used to examine the relationship between medical expenditures and ETS exposure, after controlling for other variables.[25] Gamma regression models have been shown to be multiplicative. Exponentiated coefficients were interpreted as cost ratio relative to the referent group. Gamma regression models removed zero-valued outcomes in the statistical software. Because the proportion of women with zero data for total and outpatient expenditures was small (6, 3,

Table 1. Characteristics of female nonsmokers

	Survivors				Nonsurvivors			
	Unexposed	Moderately exposed	Highly exposed	*P*-value[a]	Unexposed	Moderately exposed	Highly exposed	*P*-value[a]
No. of women	1687	1371	1494		149	77	92	
Age[b] (years)								
40–49	369 (22)	361 (26)	506 (34)	<0.001	5 (3)	9 (12)	8 (9)	0.001
50–59	456 (27)	490 (36)	442 (30)		15 (10)	19 (25)	19 (21)	
60–69	641 (38)	426 (31)	454 (30)		72 (48)	25 (32)	46 (50)	
70–79	221 (13)	94 (7)	92 (6)		57 (38)	24 (31)	19 (21)	
Mean follow-up, months (SD)	138 (40)	136 (41)	132 (45)	0.001	92 (45)	99 (37)	90 (42)	0.33
Body mass index								
<18.5 kg/m^2	63 (4)	39 (3)	43 (3)	0.14	6 (4)	4 (5)	5 (5)	0.29
18.5–24.9 kg/m^2	1148 (68)	931 (68)	977 (65)		102 (68)	52 (68)	51 (55)	
≥25.0 kg/m^2	476 (28)	401 (29)	474 (32)		41 (28)	21 (27)	36 (39)	
Alcohol drinking status								
Never	1355 (80)	1039 (76)	1151 (77)	0.06	127 (85)	61 (79)	79 (86)	0.09
Former	39 (2)	31 (2)	32 (2)		8 (5)	4 (5)	0 (0)	
Current, <3 *go* per week[c]	249 (15)	263 (19)	272 (18)		13 (9)	11 (14)	10 (11)	
Current, ≥3 *go* per week[c]	44 (3)	38 (3)	39 (3)		1 (1)	1 (1)	3 (3)	
Tertiles of dietary energy intake per day								
≤1163 kcal	592 (35)	443 (32)	452 (30)	0.07	73 (49)	28 (36)	34 (37)	0.19
1163–1440 kcal	551 (33)	461 (34)	521 (35)		40 (27)	23 (30)	25 (27)	
>1440 kcal	544 (32)	467 (34)	521 (35)		36 (24)	26 (34)	33 (36)	
Time spent walking per day								
<30 minutes	437 (26)	380 (28)	343 (23)	0.001	46 (31)	32 (42)	31 (34)	0.51
30–60 minutes	576 (34)	440 (32)	459 (31)		53 (36)	24 (31)	28 (30)	
≥60 minutes	674 (40)	551 (40)	692 (46)		50 (34)	21 (27)	33 (36)	
Self-rated health								
Good	1129 (67)	937 (68)	1019 (68)	0.60	71 (48)	36 (47)	47 (51)	0.91
Mediocre	265 (16)	210 (15)	245 (16)		25 (17)	16 (21)	16 (17)	
Poor	293 (17)	224 (16)	230 (15)		53 (36)	25 (32)	29 (32)	
Marital status								
Married	1614 (96)	1328 (97)	1472 (99)	<0.001	143 (96)	76 (99)	89 (97)	0.64
Unmarried	73 (4)	43 (3)	22 (1)		6 (4)	1 (1)	3 (3)	
Current job status								
Employed	916 (54)	784 (57)	788 (53)	0.05	57 (38)	29 (38)	40 (43)	0.67
Unemployed	771 (46)	587 (43)	706 (47)		92 (62)	48 (62)	52 (57)	
Education								
≤9 years	819 (49)	658 (48)	746 (50)	0.56	91 (61)	41 (53)	58 (63)	0.39
>9 years	868 (51)	713 (52)	748 (50)		58 (39)	36 (47)	34 (37)	

Exposure indicates exposure to environmental tobacco smoke in homes.
Values are expressed as number (column percentage), unless otherwise indicated.
Because of rounding, percentages may not add up to 100%.
[a]Differences among the 3 groups (analysis of variance for mean follow-up months and chi-square test for categorical variables).
[b]Age at baseline survey in 1994.
[c]1 *go* is equal to 180 mL of Japanese sake and contains 22.8 g of ethanol.

and 2 unexposed, moderately exposed, and highly exposed women, respectively), we added ¥1 to those who had zero expenditures to simplify the analyses. In contrast, inpatient expenditure data contained many zero-valued observations. Hence, we used logistic models to estimate the odds of any inpatient service use and then analyzed inpatient expenditures incurred only by women who had 1 or more hospitalizations.

Crude medical expenditures for moderately exposed and highly exposed women were compared with expenditures for unexposed women, which was used as the referent group. Then, analyses were age-adjusted (age strata: 40–49, 50–59, 60–69, and 70–79 years at baseline survey in 1994) and fully adjusted. The following variables were entered into the fully adjusted model: age stratum, body mass index (weight in kilograms divided by height in meters squared; <18.5, 18.5–24.9, ≥25.0),[11,26] alcohol drinking status (never, former, currently drinking <3 *go*—a traditional Japanese unit of measure equal to 180 mL of Japanese sake and containing 22.8 g of ethanol—per week, currently drinking ≥3 *go* per week), tertiles of daily dietary energy intake (≤1163, 1163–1440, >1440 kcal/day), time spent walking per day (<30, 30–60, ≥60 minutes),[27] self-rated health (good, mediocre, poor), marital status (married, unmarried), current job status (employed, unemployed), and education (≤9, >9 years). Time spent walking represented physical activity level.

The final multivariable model was similar to the fully adjusted model but included the interaction between exposure

Table 2. Monthly medical expenditures for survivors and cost ratios of expenditures for those exposed to ETS at home relative to unexposed survivors

	Median total expenditure (IQR), JPY	Total expenditure		Hospitalization		Inpatient expenditure[a]		Outpatient expenditure	
		Cost ratio (95% CI)	*P*-value	Odds ratio (95% CI)	*P*-value	Cost ratio (95% CI)	*P*-value	Cost ratio (95% CI)	*P*-value
Ratio across all age strata									
Crude ratio									
Moderately exposed		0.90 (0.83–0.97)	0.006	0.86 (0.75–0.99)	0.04	0.84 (0.74–0.96)	0.009	0.94 (0.88–1.01)	0.11
Highly exposed		0.92 (0.85–0.99)	0.02	0.83 (0.72–0.95)	0.009	1.10 (0.97–1.25)	0.14	0.89 (0.83–0.96)	0.002
Age-adjusted ratio[b]									
Moderately exposed		1.01 (0.94–1.08)	0.89	0.97 (0.83–1.12)	0.65	0.91 (0.81–1.04)	0.17	1.04 (0.97–1.11)	0.30
Highly exposed		1.05 (0.98–1.13)	0.17	0.96 (0.83–1.10)	0.53	1.15 (1.02–1.31)	0.02	1.03 (0.96–1.10)	0.38
Fully adjusted ratio[c]									
Moderately exposed		0.98 (0.91–1.05)	0.52	0.96 (0.83–1.12)	0.63	0.93 (0.82–1.06)	0.26	1.00 (0.94–1.07)	0.90
Highly exposed		1.01 (0.94–1.08)	0.87	0.94 (0.81–1.09)	0.43	1.18 (1.05–1.34)	0.007	0.98 (0.92–1.04)	0.50
Ratio in each age stratum[d]									
Age stratum 40–49 years	5900 (2800–13 100)								
Moderately exposed		0.91 (0.79–1.05)	0.20	0.89 (0.65–1.21)	0.46	0.84 (0.63–1.11)	0.21	0.97 (0.85–1.11)	0.65
Highly exposed		0.99 (0.87–1.12)	0.83	0.73 (0.54–0.98)	0.03	1.22 (0.93–1.59)	0.15	1.00 (0.89–1.13)	0.97
Age stratum 50–59 years	11 600 (4800–21 300)								
Moderately exposed		1.07 (0.94–1.21)	0.29	1.18 (0.91–1.55)	0.22	0.99 (0.78–1.26)	0.95	1.07 (0.95–1.20)	0.27
Highly exposed		0.99 (0.87–1.13)	0.91	1.07 (0.81–1.42)	0.63	1.04 (0.81–1.33)	0.77	0.98 (0.87–1.10)	0.68
Age stratum 60–69 years	21 900 (11 800–34 900)								
Moderately exposed		0.93 (0.82–1.04)	0.21	0.81 (0.63–1.03)	0.09	0.96 (0.79–1.17)	0.68	0.95 (0.85–1.06)	0.37
Highly exposed		0.94 (0.84–1.06)	0.33	0.99 (0.77–1.26)	0.92	1.06 (0.88–1.28)	0.54	0.92 (0.82–1.02)	0.12
Age stratum 70–79 years	29 900 (16 800–45 300)								
Moderately exposed		0.98 (0.78–1.24)	0.90	1.11 (0.67–1.85)	0.69	0.74 (0.53–1.03)	0.08	1.08 (0.87–1.34)	0.51
Highly exposed		1.43 (1.13–1.81)	0.003	1.18 (0.71–1.98)	0.53	1.94 (1.38–2.74)	<0.001	1.17 (0.94–1.46)	0.17

All ratios are expressed as ratio relative to women unexposed to ETS. Age indicates age at baseline survey in 1994.
ETS, environmental tobacco smoke; IQR, interquartile range; JPY, Japanese yen.
[a]Inpatient expenditures are compared among women who had 1 or more hospitalizations.
[b]Adjusted for 10-year age stratum.
[c]Adjusted for age, body mass index, alcohol drinking status, dietary energy intake, time spent walking, self-rated health, marital status, current job status, and education.
[d]Computed from a model that includes interaction term (ETS exposure level × 10-year age stratum) in addition to ETS exposure level, age, body mass index, alcohol drinking status, dietary energy intake, time spent walking, self-rated health, marital status, current job status, and education.

level and age stratum. This model with interaction enabled us to assess different ETS-attributable economic consequences by age stratum. Whether there were differences due to ETS exposure level was determined by cost ratios for each age stratum. The following SAS statements were used to calculate cost ratios of medical expenditures in the model with the interaction.

```
proc genmod data = ohsaki;
class ets age bmi alcohol diet walking
healthrating marriage job education;
model expenditure = ets age bmi alcohol diet
walking healthrating marriage job education
ets*age / dist=gamma link=log type3;
run;
```

Median total monthly expenditures per capita and interquartile ranges are presented for each age stratum. All observed expenditures were not inflation-adjusted or discounted, because medical fees were revised slightly (−3.16% to 0.80%) every 2 years during the study period. A 2-sided test was used, and a *P*-value <0.05 was considered statistically significant. All expenditures are expressed as Japanese yen (¥107 = US$1 according to the purchasing power parity rate from the Organisation for Economic Co-operation and Development National Accounts database in 2011). All statistical analyses were performed using IBM SPSS version 18 (SPSS Inc., Chicago, IL, USA) and SAS version 9.2 (SAS Institute Inc., Cary, NC, USA).

RESULTS

Participant characteristics

Table 1 shows the baseline characteristics of women not exposed, moderately exposed, and highly exposed to ETS by survival status. The age stratum 60 to 69 years had the most women (n = 1664), and the age stratum 70 to 79 years had the fewest women (n = 507). Among all women (n = 4870), 1836 (38%) were not exposed to ETS at home, 1448 (30%) were moderately exposed, and 1586 (33%) were highly exposed. Among survivors, the largest groups in the age strata 40 to 49, 50 to 59, 60 to 69, and 70 to 79 years were women who were highly exposed, moderately exposed, unexposed, and unexposed, respectively.

A total of 318 (7%) women died during the follow-up period; 22 (2%) died among 1258 women aged 40 to 49, and 100 (20%) died among 507 women aged 70 to 79. Among survivors, mean follow-up was 135 months; among nonsurvivors, mean follow-up was 93 months. Among survivors, there were significant differences in time spent walking and the proportion of married women among the 3 groups.

Medical expenditures for survivors

Median total monthly medical expenditures per capita ranged from ¥5900 (age stratum 40–49) to ¥29 900 (age stratum 70–79) among survivors (Table 2).

Table 3. Monthly medical expenditures for nonsurvivors and cost ratios of expenditures for those exposed to ETS at home relative to unexposed nonsurvivors

	Median total expenditure (IQR), JPY	Total expenditure		Hospitalization		Inpatient expenditure[a]		Outpatient expenditure	
		Cost ratio (95% CI)	*P*-value	Odds ratio (95% CI)	*P*-value	Cost ratio (95% CI)	*P*-value	Cost ratio (95% CI)	*P*-value
Ratio across all age strata									
Crude ratio									
Moderately exposed		0.68 (0.53–0.87)	0.002	0.88 (0.33–2.32)	0.79	0.71 (0.52–0.96)	0.02	0.65 (0.49–0.85)	0.002
Highly exposed		0.85 (0.68–1.08)	0.18	0.49 (0.22–1.11)	0.09	0.91 (0.68–1.22)	0.52	0.88 (0.68–1.14)	0.33
Age-adjusted ratio[b]									
Moderately exposed		0.69 (0.54–0.88)	0.003	0.94 (0.35–2.54)	0.90	0.70 (0.51–0.95)	0.02	0.70 (0.53–0.92)	0.01
Highly exposed		0.84 (0.66–1.06)	0.14	0.51 (0.22–1.18)	0.12	0.89 (0.66–1.20)	0.45	0.85 (0.66–1.10)	0.22
Fully adjusted ratio[c]									
Moderately exposed		0.69 (0.54–0.87)	0.002	1.11 (0.39–3.19)	0.85	0.66 (0.48–0.90)	0.009	0.76 (0.59–0.99)	0.04
Highly exposed		0.90 (0.71–1.13)	0.36	0.57 (0.23–1.39)	0.22	0.92 (0.67–1.26)	0.60	0.93 (0.73–1.18)	0.54
Ratio in each age stratum[d]									
Age stratum 40–49 years	48 200 (16 800–72 200)								
Moderately exposed		0.73 (0.28–1.86)	0.50	NA		0.52 (0.16–1.66)	0.27	1.14 (0.42–3.09)	0.79
Highly exposed		0.97 (0.37–2.49)	0.94	NA		1.30 (0.40–4.17)	0.66	0.57 (0.21–1.55)	0.27
Age stratum 50–59 years	57 600 (22 500–111 400)								
Moderately exposed		0.58 (0.32–1.05)	0.07	1.60 (0.18–13.89)	0.67	0.70 (0.33–1.48)	0.35	0.41 (0.22–0.77)	0.005
Highly exposed		1.05 (0.58–1.92)	0.87	0.51 (0.07–3.64)	0.50	1.54 (0.70–3.38)	0.28	0.60 (0.32–1.12)	0.11
Age stratum 60–69 years	69 500 (34 600–114 100)								
Moderately exposed		0.75 (0.51–1.11)	0.15	NA		0.78 (0.48–1.26)	0.31	0.65 (0.43–0.98)	0.04
Highly exposed		0.78 (0.57–1.07)	0.12	0.61 (0.19–1.99)	0.41	0.75 (0.49–1.14)	0.17	0.91 (0.65–1.27)	0.57
Age stratum 70–79 years	52 700 (32 400–108 000)								
Moderately exposed		0.69 (0.46–1.05)	0.08	0.41 (0.08–2.18)	0.29	0.60 (0.34–1.05)	0.07	1.03 (0.67–1.59)	0.90
Highly exposed		1.03 (0.65–1.64)	0.90	0.71 (0.09–5.50)	0.74	0.87 (0.48–1.58)	0.65	1.35 (0.83–2.18)	0.23

All ratios are expressed as ratio relative to women unexposed to ETS. Age indicates age at baseline survey in 1994.
ETS, environmental tobacco smoke; IQR, interquartile range; JPY, Japanese yen; NA, not applicable.
[a]Inpatient expenditures are compared among women who had 1 or more hospitalizations.
[b]Adjusted for 10-year age stratum.
[c]Adjusted for age, body mass index, alcohol drinking status, dietary energy intake, time spent walking, self-rated health, marital status, current job status, and education.
[d]Computed from a model that includes interaction term (ETS exposure level × 10-year age stratum) in addition to ETS exposure level, age, body mass index, alcohol drinking status, dietary energy intake, time spent walking, self-rated health, marital status, current job status, and education.

Crude, age-adjusted, and fully adjusted (the model without the interaction) cost ratios for moderately exposed and highly exposed survivors, as compared with unexposed survivors, are shown in Table 2. Cost ratios of total (ie, inpatient plus outpatient care), inpatient and outpatient expenditures, and odds ratios of hospitalization were calculated for moderately exposed and highly exposed women in relation to unexposed women, which was used as the referent category.

We found significant differences in some crude total, inpatient, and outpatient expenditures associated with ETS exposure. For example, crude total expenditures were lower for moderately exposed and highly exposed women than for unexposed women. In contrast, we found no significant difference in age-adjusted or fully adjusted total expenditures, regardless of exposure, although age-adjusted and fully adjusted inpatient expenditures were higher for highly exposed women than for unexposed women.

There were significant differences in the fully adjusted model with the interaction term between exposure level and age stratum (Table 2). Total expenditure for age stratum 70 to 79 years was higher for highly exposed women than for unexposed women after adjusting for other variables (cost ratio, 1.43; 95% CI, 1.13–1.81). The difference in total expenditure between unexposed and moderately exposed women was not significant.

When inpatient and outpatient care were analyzed separately, inpatient expenditure was higher for highly exposed women than for unexposed women (cost ratio, 1.94; 95% CI, 1.38–2.74), although there was no significant association between probability of hospitalization and exposure level. We found no difference in adjusted outpatient expenditures for age stratum 70 to 79 years, regardless of exposure.

In the age strata 40 to 49, 50 to 59, and 60 to 69 years, total, inpatient, and outpatient medical expenditures did not significantly differ, regardless of exposure (Table 2). However, inpatient expenditures tended to be higher for highly exposed women than for unexposed women among all these strata.

Medical expenditures for nonsurvivors

Median total monthly medical expenditures per capita ranged from ¥48 200 (age stratum 40–49) to ¥69 500 (age stratum 60–69) among nonsurvivors (Table 3).

Crude, age-adjusted, and fully adjusted (the model without the interaction) cost ratios for moderately exposed and highly exposed nonsurvivors, as compared with unexposed nonsurvivors, are shown in Table 3. Crude, age-adjusted, and fully adjusted total expenditures were lower for moderately exposed nonsurvivors than for unexposed nonsurvivors.

Table 3 also shows cost ratios of medical expenditures for nonsurvivors in the fully adjusted model with the interaction between exposure level and age stratum. In all age strata, including age stratum 70 to 79 years, we found no significant difference in total expenditure regardless of exposure, although outpatient expenditures for the age strata 50 to 59 and 60 to 69 years were lower for moderately exposed nonsurvivors than for unexposed nonsurvivors.

DISCUSSION

To calculate expenditures attributable to ETS, we analyzed medical expenditures incurred by female nonsmokers who were not exposed, moderately exposed, and highly exposed to ETS in the home. Among highly exposed survivors aged 70 to 79 years, we found that a substantial increase in total medical expenditure was possibly attributable to ETS exposure at home. This excess expenditure suggests a significant age-specific association between ETS exposure and total medical expenditure.

The association of ETS exposure with economic impact is consistent with known clinical relationships and provides an explanation for the economic burden. Although our significant findings regarding total expenditures are limited to older survivors, they support the results of previous simulation studies[16–21] that estimated the economic burden caused by ETS-attributable diseases at the national, regional, and state levels rather than the individual level.

Interpretation of findings

High ETS exposure resulted in significantly higher inpatient but not outpatient expenditures among survivors aged 70 to 79 years, which suggests that the excess total expenditure arose from treatment for serious but nonfatal diseases rather than from treatment for relatively minor disorders.

ETS exposure significantly increased total medical expenditures only among survivors aged 70 to 79 years. One plausible explanation for this result is that it takes many years to produce a significant difference in total medical expenditures between unexposed and highly exposed adults, because the harm of ETS is subtle in comparison to active smoking. Another likely explanation is that diseases result in higher morbidity among older versus younger adults. Notably, among women aged 40 to 69 years, highly exposed women tended to incur higher inpatient expenditures than unexposed women, which suggests that serious but nonfatal diseases attributable to ETS are already present among highly exposed women in these age strata.

In contrast to survivors, we found no significant age-specific association between total medical expenditures incurred by nonsurvivors and ETS exposure, perhaps because ETS exposure does not increase costs of therapy for fatal diseases, although exposure increases the incidence of such diseases. In contrast to our findings among nonsurvivors, ETS-attributable excess total expenditures among survivors may arise from the accumulation of excess morbidities from nonfatal and near-fatal diseases.

The results for nonsurvivors in age strata 50 to 59 and 60 to 69 years showed that moderately exposed nonsurvivors incurred lower outpatient expenditures as compared with unexposed nonsurvivors, possibly because relatively low doses of toxins inhaled from ETS are pathophysiologically sufficient to elicit a strong acute effect on the cardiovascular system, whereas lung cancer is caused by long-term exposure.[28] This evidence suggests that ETS exposure causes rapid onset of coronary heart disease and subsequent death in these age strata, which may account for the lower monthly outpatient expenditure.

Strengths and limitations of the study

Our study has several advantages as compared with previous studies. To the best of our knowledge, this is the first study using directly observed long-term individual-level health insurance records to show a significant association between ETS exposure and medical expenditures among adults. Previous studies estimated population-level ETS-attributable expenditures by using economic models of mixed results from multiple databases, such as the published literature and macrodata on ETS exposure, increased morbidity, and medical costs.[16–21] We showed the individual-level economic burden imposed by ETS exposure by means of comparison within a single cohort.

Furthermore, we followed a large cohort for a long period. The expenditures in our analyses were accurate because we obtained health insurance claims data directly from the Miyagi NHI Organizations, which included information on almost all available medical services. Long-term observation allowed average monthly expenditure to be unaffected by short-term incidental use of medical services.

Our study has several limitations. First, assessment of ETS exposure was based on a questionnaire survey. Misclassification of exposure status is a concern in studies that use only questionnaires. Quantitative information on ETS exposure is less reliable in questionnaires, but information on whether exposure is heavy or light is relatively reliable.[29,30] Second, the questionnaire in our study focused on ETS exposure at 1 time point, as we assumed that exposure status at baseline was correlated with past exposure. To ensure the correctness of this assumption, we excluded women with a change in job status or marital status during their lifetime. Nevertheless, further research based on long-term continuous ETS exposure measurement is required. Third, all medical expenditures were included in our analysis. There were no available cost data for specific diseases such as lung cancer and coronary heart disease. However, diseases attributable to ETS exposure range from life-threatening diseases to relatively minor disorders (eg, respiratory tract symptoms).[31] This is similar to active smoking, which has been reported to

be relevant to many diseases, including major smoking-related diseases.[32] Previous studies of the association between active smoking and medical expenditures have also addressed overall disease burden.[9,10] Furthermore, if we analyzed expenditures for specific diseases that were strongly associated with ETS exposure, we might also find significant relationships between ETS exposure and total expenditures for younger women. Future studies of real-world medical expenditures for diseases strongly associated with ETS exposure may be needed to verify the results of previous studies that simulated the excess costs attributable to ETS by combining ETS-attributable diseases and associated medical costs. Finally, long-term care (LTC) insurance claims data were not available. Japan has a LTC insurance system that supports elderly adults living at home or in nursing-care facilities. We believe that women that incur more medical expenditures for treatment of diseases due to ETS exposure may also use more LTC services than women unexposed to ETS.

We examined household ETS exposure because previous cohort studies of the health effects of ETS focused on ETS exposure at home or at work.[1,2,5] How applicable are our results to ETS exposure outside the home? Considerable evidence of increased mortality and morbidity related to ETS exposure has also been obtained from exposure in workplaces and public places.[4,5,33] We believe that ETS exposure in settings other than the home also increases medical expenditures. Medical expenditures attributable to ETS exposure in the workplace and other settings need to be explored.

This study analyzed the self-employed, part-time workers, the unemployed, and their families. These groups may spend more time at home than corporate employees, who are covered by Employees' Health Insurance. Thus, the effects of household ETS might be more severe in the present study population than in corporate employees and their families.

Conclusions

We found that severe household ETS exposure results in excess total medical expenditures. Surviving female nonsmokers aged 70 to 79 years who were highly exposed to ETS at home incurred significantly higher total medical expenditures than those living in smoke-free households. The present study provides information on the economic burden of ETS, although significant findings regarding total expenditure are limited to surviving older women. This information should help policymakers to develop strategies that reduce secondhand smoke and hasten the economically attractive goal of eliminating ETS. Further research is required to examine the association between accumulated ETS exposure and medical expenditure.

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ONLINE ONLY MATERIALS

The Japanese-language abstract for articles can be accessed by clicking on the tab labeled Supplementary materials at the journal website **http://dx.doi.org/10.2188/jea.JE20120072.**

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総　説

ミニ特集
第81回日本衛生学会
健康増進・地域医療・医療費適正化計画とデータ活用
～生活習慣病の予防・治療システムの戦略的構築へ～

喫煙者と非喫煙者の生涯医療費

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Lifetime Medical Expenditures of Smokers and Nonsmokers

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Abstract　**Objectives:** The aim of this study was to examine which of the two groups have higher lifetime medical expenditures; male smokers or male nonsmokers. We conducted this investigation using a Japanese single cohort database to calculate long-term medical expenditures and 95% confidence intervals.

Methods: We first constructed life tables for male smokers and male nonsmokers from the age of 40 years after analyzing their mortality rates. Next, we calculated the average annual medical expenditures of each of the two groups, categorized into survivors and deceased. Finally, we calculated long-term medical expenditures and performed sensitivity analyses.

Results: The results showed that although smokers had generally higher annual medical expenditures than nonsmokers, the former's lifetime medical expenditure was slightly lower than the latter's because of a shorter life expectancy that resulted from a higher mortality rate. Sensitivity analyses did not reverse the order of the two lifetime medical expenditures.

Conclusions: In conclusion, although smoking may not result in an increase in lifetime medical expenditures, it is associated with diseases, decreased life expectancy, lower quality of life (QOL), and generally higher annual medical expenditures. It is crucial to promote further tobacco control strategically by maximizing the use of available data.

Key words: smoking（喫煙）, lifetime medical expenditure（生涯医療費）, mortality（死亡率）, cohort study（コホート研究）, tobacco control（たばこ規制）

I. 緒　言

喫煙はがん，心疾患，脳血管障害，糖尿病（2型），高血圧などの生活習慣病と深く関連しており（1–4），わが国における喫煙による死亡数は2005年の時点で年間19.6万人と推定されている（5）。欧米先進国では，喫煙は予防しうる最大の疾病・早死の原因との認識のもと，種々

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の喫煙対策が実施され成果を上げている (6, 7)。近年医療費が高騰するなか，我が国でも喫煙の健康への影響だけでなく，医療費への影響，特に長期的影響（生涯医療費）に大きな関心が寄せられている。これは疾病予防と健康増進によって医療費節減効果がもたらされるかに関する一例といえるからである。

喫煙者の生涯医療費が非喫煙者に比べて高額か否かについては，これまで国内外を問わず多くの議論がなされてきている。わが国においては，短期間での医療費は喫煙者の方が非喫煙者に比べて高額であるという先行研究 (8) はあるものの，喫煙者の年間医療費は高額である反面余命は短いため，喫煙者と非喫煙者のどちらの生涯医療費が高額かはっきりしていない。

諸外国ではこれまで，喫煙と生涯医療費の関係についていくつかの研究が実施されており，それらの研究結果では，Manning ら (9), Hodgson ら (10), Mackenzie ら (11), Rasmussen ら (12) は喫煙者のほうが高額であるとしたが，Leu ら (13), Lippiatt (14), Barendregt (15) は非喫煙者のほうが高額であるとした。つまり生涯医療費に関しては，喫煙者の方が高い結果もあれば低い結果もあり，一致した結果が示されていないのが現状である。

ただしこれらの研究には，計算の正確性における限界があることは否めない。というのも，これらの研究の多くは，生涯医療費を算出するために構築した経済学的なモデルに，喫煙者と非喫煙者の国レベルで集約されたマクロデータを適用することで，あるいは喫煙と発症が強く関連している疾患に限定しその医療費増加データを用いることで，生涯医療費を推計したものであり，複数のデータベースのミックスによる計算結果，あるいは限定した疾患に関する医療費にすぎないからである。

そこで本研究では，わが国で実施されている単一のコホート研究（追跡研究）によって収集された個人レベルのデータに単純な計算モデルを用いることで，喫煙者と非喫煙者の余命，年間平均や中長期の医療費について，より直接的に算出することを目的とした。

II. 研究方法

1. 解析データ

本研究では，宮城県の「大崎コホート研究」で得られた40～79歳（1994年8月31日時点）の男性の国民健康保険加入者24,573人の11年間にわたるデータを用いた。また，大崎国保コホート研究のデータベースに含まれない高齢の死亡率の推定のため，平成17年の完全生命表である第20回生命表のデータを用いた。

この「大崎コホート研究」は東北大学社会医学講座公衆衛生学分野が，宮城県大崎保健所管内1市3町（当時）に住む国民健康保険加入者で，1994年8月31日時点で40～49歳の全員30,294名を対象に同年10～12月に自記式アンケート調査による生活習慣などに関するベースライン調査を実施し，1995年1月以後の医療利用状況についてレセプトデータ等を用いて追跡しているものである (16)。ベースライン調査の項目は性別，年齢などの基本的情報や病歴，身体機能，喫煙や食習慣等，健康に関する生活習慣である。ベースライン調査の有効回答者52,029名のうち，1995年1月のレセプトデータ追跡開始時までに死亡または転出したものを除外した51,255人について，1995年1月から毎月，宮城県国民健康保険団体連合会からデータの提供をうけて国民健康保険レセプトとレコードリンケージをおこない，受診状況，医療費を継続して把握している。また対象者の死亡や転出による異動に関しても，1995年1月からの国民健康保険の喪失異動データとのレコードリンケージにより追跡している。

2. 解析方法

(1) 生命表（喫煙者・非喫煙者）の作成

①各年齢の死亡確率の推定

喫煙状況別の各年齢における死亡確率についてロジスティック回帰モデルを用いて推定した。

②シミュレーションによる生命表の作成

40歳を起点とした喫煙者と非喫煙者それぞれの10万人のコホートを設定し，推定された各年齢における死亡確率を用いてシミュレーションすることで生命表を作成した。なお，大崎国保コホート研究のデータベースに含まれない高齢の死亡率に関しては，喫煙状況にかかわらず同じ値を用いることとし，完全生命表における死亡率を用いた。

(2) 1年間医療費の平均の算出

年齢別・喫煙状況別・生存死亡別にデータを区分し，年間医療費（入院・入院外）の平均（1人あたりの年間医療費の平均）を算出した。

(3) 生涯医療費を含めた中長期の累積医療費（1人あたりの換算値）の算出シミュレーション

中長期の累積医療費（1人あたりの換算値）を算出するにあたり，まずコホート全体の累積医療費を算出するために，「各年齢の生存・死亡者数」と「1人あたりの年間医療費の平均（年齢別・喫煙状況別・生存死亡別）」から各年齢の医療費全体（喫煙状況別）を算出した後，ある年齢までの総和（コホート全体の医療費）を算出した。その後今回は10万人のコホートを設定したため，コホート全体の医療費を10万で除すことで1人あたりに換算した。将来の金銭的価値は現在価値に換算すると低い評価となるため，経済的評価においては，未来の金銭的価値について割り引く必要がある。そのため本研究では，ベースシナリオとして累積医療費（全体，入院，入院外）に対して，近年一般的な3%の割引率を設定した。また感度分析のために，3%の割引率に加えて，なし（0%），1%, 5%の全部で4種類の割引率を設定するとともに，平均余命や生涯医療費の95%信頼区間をブートストラップ法を用いて算出した。

解析・集計ソフトは，SPSS 17.0J for Windows と EXCEL 2007 for Windows を用いた。

表1 年齢・喫煙状況が生死に与える影響（男性）

説明変数		係数	オッズ比	95% 信頼区間	p 値
年齢		0.0915	1.10	(1.09–1.10)	0.000
喫煙経験	なし（基準）		1.00		
	あり	0.417	1.52	(1.38–1.67)	0.000
切片		−10.6			
Hosmer-Lemeshow test			χ^2 値＝7.126		p＝0.52
C-statistics			0.743	(0.735–0.750)	

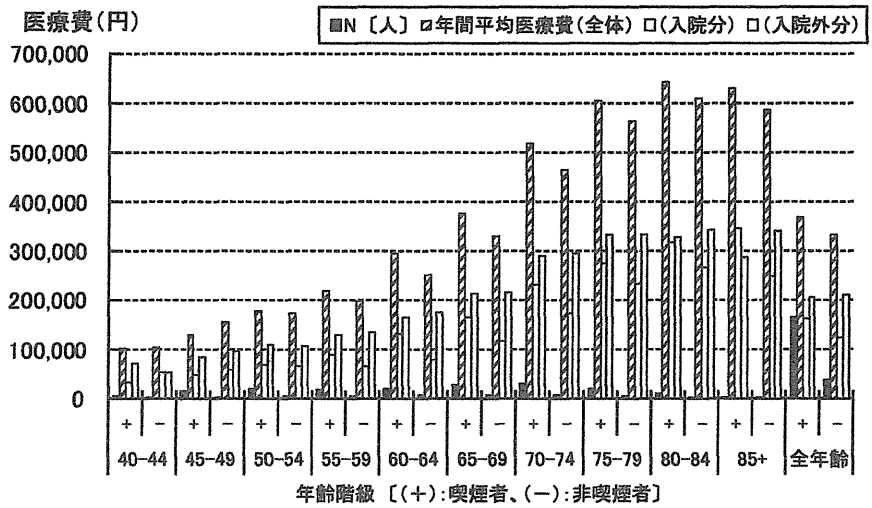

図1 年齢区分・喫煙状況別1年間平均医療費（入外別）（男性：全体（生存者・死亡者））

III. 研究結果

(1) 生命表（喫煙者・非喫煙者）の作成

ロジスティック回帰分析の結果，年齢が上がるほど，また喫煙者であるほど死亡のリスクが高かった。オッズ比はそれぞれ1.10 (95% 信頼区間：1.09–1.10)，1.52 (1.38–1.67) であり，統計的に有意な結果であった（表1）。それらの値から算出される各年齢での死亡確率を用いて生命表を作成したところ，40歳平均余命は喫煙者で39.6歳，非喫煙者で43.1歳と非喫煙者の方が長かった。

(2) 1人あたり年間医療費の平均の算出

1人あたり年間医療費（年齢階級別）の平均を生存者死亡者あわせた全体で算出したところ，40歳代を除き喫煙者の方が高額であった（図1）。生存者・死亡者で区別すると生存者の場合，全体の結果と同様に40歳代を除き喫煙者の方が高額であった（図2）が，死亡者の場合特にはっきりした傾向はなかった（図3）。

(3) 生涯医療費の算出シミュレーション

生涯医療費については，非喫煙者621万円，喫煙者600万円となり，非喫煙者の方が3.3%高額であった（図4）。しかし，入院医療費に限ってみると喫煙者群の方が高額であった。

複数の割引率（なし，1%，3%，5%）を用いた累積医療費を把握したところ，生涯医療費に関しては，すべての割引率において非喫煙者の方が喫煙者より高額（割引率なし：89万円差，割引率1%：54万円差，割引率3%：21万円差，割引率5%：9万円差）であった。また，中長期の累積医療費に関しては，割引率なしの場合22年後となる62歳時点から43年後となる83歳時点までの期間に関して，割引率1%の場合22年後となる62歳時点から41年後となる81歳時点までの期間に関して，割引率3%の場合24年後となる64歳時点から41年後となる81歳時点までの期間に関して，割引率5%の場合24年後となる64歳時点から40年後となる80歳時点までの期間に関しては，喫煙者群の累積医療費の方が非喫煙者群のそれより高額という結果であった（図5）。ブートストラップ法を用いた喫煙者と非喫煙者間の平均余命や生涯医療費の95%信頼区間に関しては，表2の通りであった。

IV. 考　　察

本研究では単一のコホート研究によって収集された個人レベルのデータを用いて，喫煙状況別の各年齢における死亡確率や1人あたり年間医療費の平均を算出し，現在40歳である男性の喫煙者と非喫煙者の余命，生涯医療費を含む中長期の累積医療費を算出した。その結果，(1)

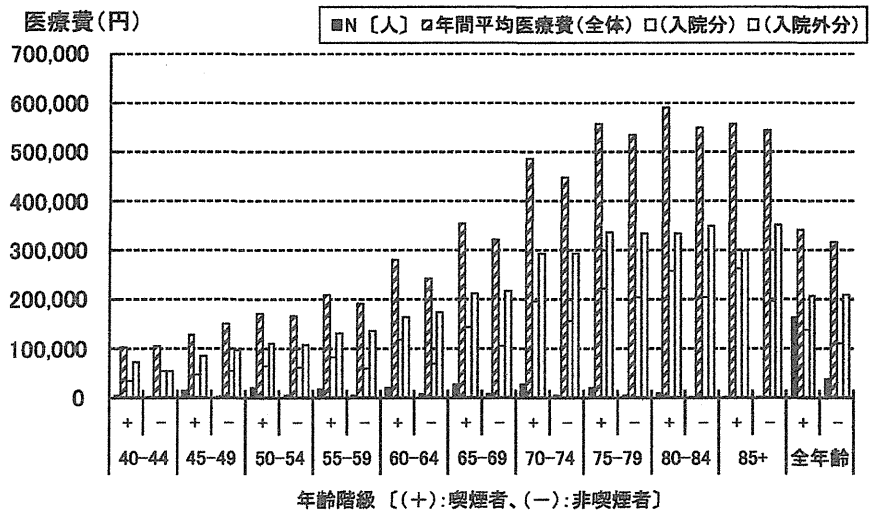

図2　年齢区分・喫煙状況別1年間平均医療費（入外別）（男性：生存者）

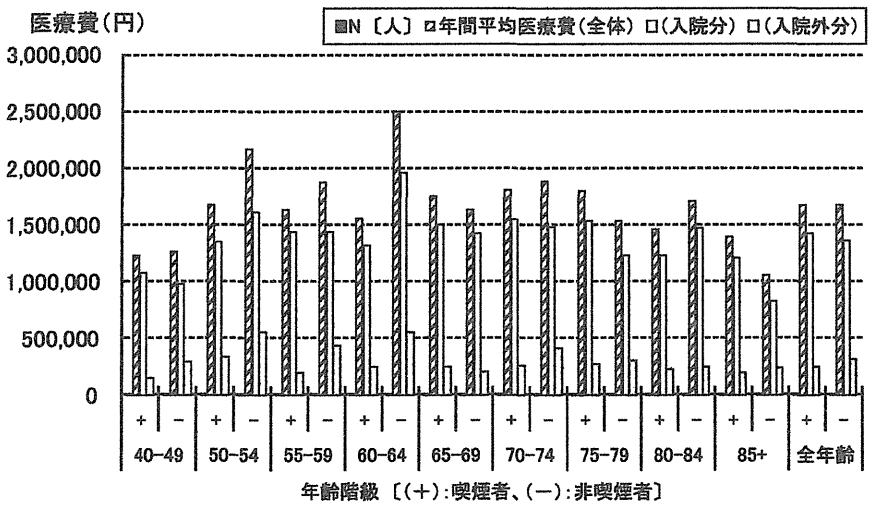

図3　年齢区分・喫煙状況別1年間平均医療費（入外別）（男性：死亡者）

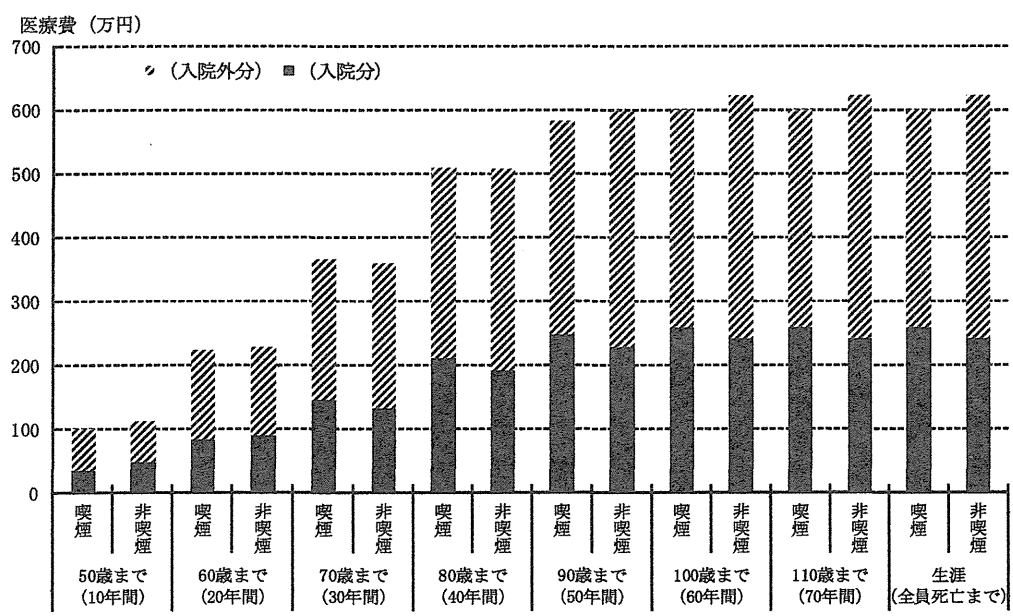

図4　喫煙群と非喫煙群の40歳からの中長期の累積医療費（全体，入院，入院外）（1人あたり換算値）（割引率：3%）

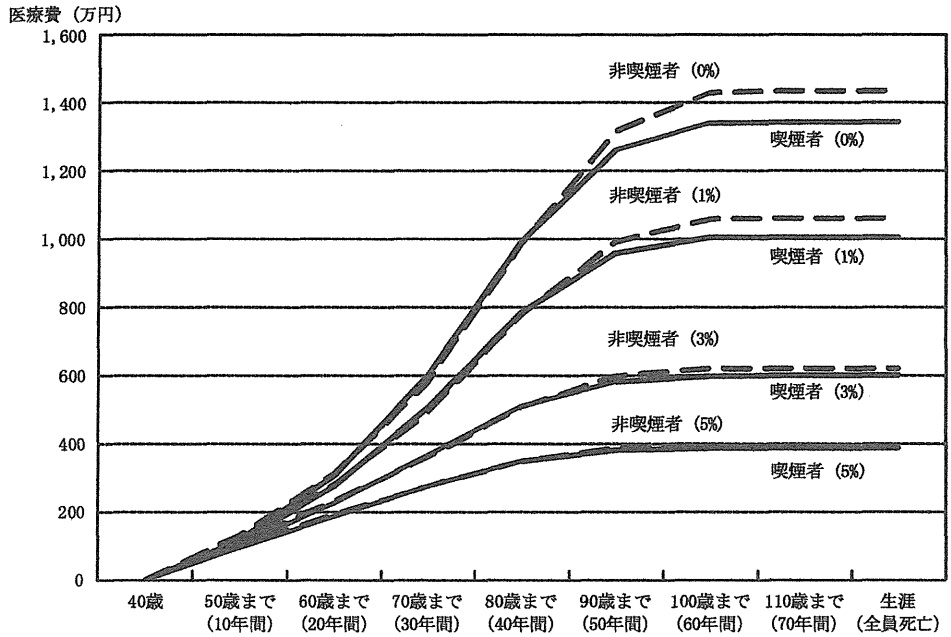

図5　喫煙群と非喫煙群の40歳からの中長期の累積医療費（1人あたり換算値）（割引率：なし，1，3，5%）

表2　40歳からの平均余命と生涯医療費（男性）

平均余命（年）		喫煙者	39.8	(39.5–40.1)
		非喫煙者	43.3	(42.6–43.5)
生涯医療費（万円）	割引率 0%	喫煙者	1,333	(1,334–1,366)
		非喫煙者	1,444	(1,408–1,482)
	割引率 1%	喫煙者	1,013	(999–1,020)
		非喫煙者	1,067	(1,043–1,098)
	割引率 3%	喫煙者	602	(597–608)
		非喫煙者	624	(616–644)
	割引率 5%	喫煙者	388	(386–394)
		非喫煙者	397	(394–412)

喫煙者が非喫煙者より死亡のリスクが高く短命であること，(2) 1人あたり年間医療費の平均は，全体で見ると喫煙者が非喫煙者より高額であること，(3) 中長期の累積医療費は，60～80歳頃までは喫煙者が非喫煙者より高額であったが，生涯医療費で見ると非喫煙者が喫煙者より高額であること，(4) 感度分析を実施しても，喫煙者と非喫煙者の生涯医療費の関係が逆転するような影響はないことがわかった。

(1) 喫煙者と非喫煙者の医療費

本研究の結果，生涯医療費に関しては喫煙者が非喫煙者よりわずかに低いと示唆され，いくつかの先行研究 (13–15) の結果と一致した。これは喫煙者の方が年間の医療費は高額であるが非喫煙者と比較して短い余命であるためだと考えられる。また割引率を変化させて感度分析を実施したところ，割引率が大きいほど非喫煙者と喫煙者の生涯医療費の差は縮まったが，前者の方が高額であることに変わりはなく，結果が大きく変わるような影響はなかった。おそらく喫煙は，年間医療費を高額にする影響はあるものの，生涯医療費を高額にする影響はないと考えられる。しかし中長期の累積医療費に関しては，60～80歳代(40歳開始時点の20～40年後)までの場合，非喫煙者の医療費が喫煙者よりわずかに低額であった。

(2) 喫煙者と非喫煙者の平均余命

本研究では，40歳男性の平均余命は喫煙者39.6年，非喫煙者43.1年であり，非喫煙者の方が3.5年長かった。この結果は他のコホート集団を用い別の方法で算出した先行研究の結果 (17) とほぼ一致しており，40歳の平均余命は喫煙者と非喫煙者において約3.5年の違いが出ると考えられる。この3.5年という長さはイギリスでの研究結果 (1) と比較すると短い結果であったが，これは (1) 日本では分煙が不十分であり，受動喫煙により非喫煙者もたばこの影響を受けていた可能性，(2) 1994年の一時点でのみの喫煙状況であったので喫煙状況に変化が起こっていた可能性，(3) 質問紙票による喫煙状況の調査に正確に回答していなかった対象者がいた可能性等が考えられる。

(3) 生涯医療費算出における単一コホートデータの活用（たばこを例として）

本研究は，長期間追跡されている単一のコホートデータを用いて分析が実施された研究であり，従来研究のような国家レベルのマクロデータなどを結合し経済モデルを適用する研究 (ｼｰﾄｺ) に比して，生涯医療費の算出の正確性が上がったと考えられる。それは，コホートのデータを用いることで，個人ベースのデータにアクセスする

ことができ，年齢や喫煙状況による死亡確率の推定，あるいは年齢・喫煙状況・生死の状態による年間の医療費の平均を分析することが可能となったからである。そのため例えば，喫煙者は同じ年齢区分の非喫煙者より全体でみると高い年間医療費であったが，それを生存者と死亡者に区分したり，入院患者と入院外患者で区分したりすると，わずかながらとはいえ反対の傾向であることが導き出された。今まで喫煙者群と非喫煙者群に関するコホートデータがなかったため，こうした生存者と死亡者を区分した医療費に関する分析はほとんど行われてこなかったが，今回生存者と死亡者を層別した分析の重要性も示唆された。

V. 結　　語

今回の分析結果により，非喫煙者が喫煙者より生涯医療費はわずかに高く平均余命は長いことが示唆された。これらから喫煙で生涯医療費が上がることはないと考えられるが，喫煙は様々な疾患の発症に関係していることも明らかであり，そのため余命を短くし生活の質 (QOL) を低下させ，また年間の医療費を高額にする。健康でQOLの高い生活を送ることは皆の願いであり，今後も喫煙対策を進めることは重要であろう。

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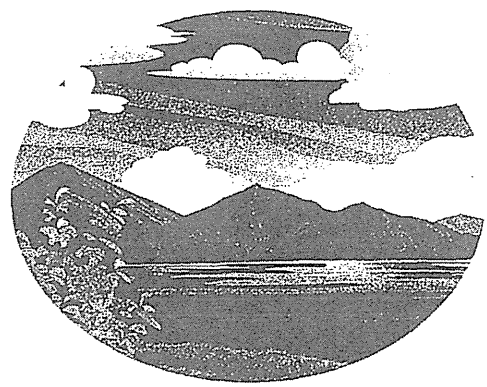
事例で学ぶ

禁煙治療のための カウンセリングテクニック

【エキスパート編】

著 谷口千枝　編集 田中英夫



看護の科学社

はじめに

2009年8月に看護の科学社から出版された『－ 事例で学ぶ － 禁煙治療のためのカウンセリングテクニック』は，主にこれから禁煙治療に従事する医療職を対象として，事例中心のマニュアル本として作成しました。あれから3年が経過し，読者の一部から，「カウンセリングの理論を用いた，より専門的な禁煙治療のためのカウンセリング技法について学びたい」という声が寄せられました。そこで，禁煙治療で用いるカウンセリング技術のレベルアップを図りたい医療職を想定した「エキスパート編」を同社から再び刊行することになりました。

本書の最大の特徴は，日本で禁煙治療がはじまる前に海外で理論構築されていた様々なカウンセリングに関する一般理論の中から，著者の喫煙者に対するカウンセリングの豊富な経験に基づいて，禁煙治療への適用を念頭に，諸理論を比較・整理したことにあります（第1章）。そして，その比較・整理に基づいて，禁煙カウンセリングに役立つ理論と技術を，「聴く」「分析（評価）する」「介入する」という，医療行為の基本的な思考パターンに近い3つのカテゴリーに新たに分類して再構築したことです（第2，3，4章）。これによって，これまで読者の皆さんが頭の中でモヤモヤしていたカウンセリングの一般理論と効果的な禁煙カウンセリングの実践との対応が，スッキリするのではないかと思われます。

また，前書でも好評だった，禁煙カウンセリングのプロセスレコードのうち，失敗例を中心に今回も提示しています（第6章）。何がどう失敗だったか，そしてどうすれば良かったのかを，再構築されたカウンセリング理論から学べるように工夫してあり，これを読み解くことでスキルアップの効果が期待できるものと思われます。さらに，禁煙治療中によく見られる患者さんの体重増加への指導など，身体的な問題の対処についても今回新たに追加しました（第5章）。

本書が禁煙治療における個別指導，カウンセリングの技術に行き詰まりを感じていたり，さらにレベルアップを図りたいと考えておられる方の一助となりましたら幸いです。また，本書の作成後に感じたことですが，本書が記すカウンセリングの理論構成と技術は，禁煙だけでなく，食事や運動などのその他の保健行動の変容を目指した指導，カウンセリングにも応用できる部分が多いと思われます。

最後になりましたが，本書の企画にインスピレーションとモチベーションを与えて下さった，多くの禁煙外来の患者さんに心から謝意を表します。

平成24年7月20日

編者
田中 英夫

目次

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Original Article

Necessity and Readiness for Smoking Cessation Intervention in Dental Clinics in Japan

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ABSTRACT

Background: The necessity and readiness for smoking cessation intervention in dental clinics was assessed by investigating smoking status and stage of behavior change in patients and the attitudes of dentists toward the effects of smoking on their patients, respectively.

Methods: A self-administered questionnaire was mailed to 1022 dentists randomly selected from the Japanese Dental Association database. The questionnaire survey consisted of 1 section for dentists and 1 for patients aged 20 years or older and was scheduled to be completed at the dentists' clinics on a designated day in February 2008.

Results: The response rate to the questionnaire was 78.2% from among target dental clinics and 73.7% and 74.7% for patient and dentist questionnaires, respectively. Data from 11 370 patients and 739 dentists were analyzed. The overall smoking prevalence among the patients (25.1%) was similar to that reported by the National Health and Nutrition Examination Survey, and young female patients had a markedly higher smoking prevalence. More than 70% of patients who smoked were interested in quitting. Although the prevalence of current smoking among dentists (27.1%) was significantly higher than that reported among Japanese physicians (15.0%), approximately 70% of dentists were concerned about the effects of smoking on patient health and prohibited smoking inside their clinic.

Conclusions: Many smokers who were interested in quitting, particularly young women, visited dental clinics, and most dentists believed that smoking was harmful for their patients. These results indicate that smoking cessation intervention in dental settings is necessary and that dentists are ready to provide such interventions.

Key words: dentist; patient; health care survey; smoking; smoking cessation

INTRODUCTION

Smoking is the most important preventable cause of morbidity and mortality. The prevalence of metabolic syndrome is higher among Japanese male smokers than among their nonsmoking counterparts.[1] The estimated population-attributable fraction of all-cause mortality due to smoking among Japanese aged 40 to 79 years is 27.8% in men and 6.7% in women.[2] In Japan, the prevalence of smoking in men is the highest among industrialized countries, whereas that in women is low but has recently increased. Current smoking patterns indicate that comprehensive tobacco control programs should be implemented to reduce the public health burden of smoking-related diseases, which will persist over the next several decades if necessary measures are not taken.[3]

Health professionals have a prominent role in tobacco control.[4] They interact with smokers when tobacco users are most open to health advice and help them quit smoking through the services they provide in their daily practices. Many studies have shown that behavioral counseling and pharmacotherapy by health professionals are effective in managing nicotine dependence.[5–7] Treatment delivered by clinicians in different specialties increased abstinence rates and was more effective than interventions delivered by clinicians in a single speciality.[8] In short, a multidisciplinary approach is required to identify smokers and treat nicotine dependence.

Dental clinics are expected to have a unique role in creating strategies for smoking cessation intervention.[9] Oral screening and patient education have always been an important part of routine dental practice. Dental visits therefore provide dental professionals with frequent opportunities to educate their patients with regard to the effects of smoking.[10,11] In addition, many studies have reported the efficacy of smoking cessation

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interventions in the dental setting (ie, the effectiveness of interventions under ideal conditions). A systematic review revealed that behavioral interventions conducted by dental professionals for tobacco users also increased abstinence rates.[12] Another study reported that the smoking abstinence rate approximately tripled after 1 year of counseling by dental professionals using pharmacologic aids.[13]

Although the potential and efficacy of smoking cessation programs in dental practice are known, the necessity and readiness for such interventions remain unclear because there are few large-scale studies or healthcare data on such interventions in dental clinics. Such data could be used to evaluate how many smokers visit dental clinics, how many are interested in quitting, and how many can be referred to medical institutions for treatment of nicotine dependence. In addition, there are insufficient data on dentists' attitudes and concern toward the effects of smoking on their patients, which could affect such interventions in their practice.

The present study assessed the necessity and readiness of dental clinics to execute interventional programs for smoking cessation among patients. The study evaluated smoking status, stage of behavior change, and the level of nicotine dependence among dental patients, as well as smoking status among dentists and their attitudes toward the effects of smoking on their patients.

METHODS

Data collection

An economic study was designed and conducted to test the hypotheses that smoking-related dental diseases increase the costs of dental care and that smoking cessation interventions in dental clinics decrease those costs. This survey of dental clinics was conducted as part of that economic study. The survey was conducted at each dental clinic on a designated day during the period from 19 to 22 February 2008. Reminder letters were sent twice to nonrespondents, in May and July 2008. For the survey, 1022 dentists were randomly selected from the list of general dental practitioners registered with the Japan Dental Association (JDA; total membership 65 329) in fiscal 2007. The survey comprised 2 parts: 1 for dentists and 1 for their patients. Each dental clinic received a self-administered questionnaire requiring no name identification, a recommendation letter from the director of the JDA, and a cover letter requesting the return of the completed questionnaire by mail. Patients aged 20 years or older who visited the dental clinic on the designated day were informed of the study protocol by their dentist. Patients who gave informed consent to participate in the study completed the questionnaire while waiting for their appointment. Each dentist was asked to enclose the completed questionnaire in an envelope, seal it, and return it in a pre-addressed stamped envelope. The study protocol was approved by the Ethics Committee of Fukuoka Dental College (Ethics Approval No. 115).

Measures

The questionnaire included questions regarding the smoking status of patients, their readiness to quit smoking, and nicotine dependence. Smoking status was defined as follows: current smoker (an individual who currently smokes and has smoked more than 100 cigarettes since starting), former smoker (an individual who does not smoke currently but has previously smoked more than 100 cigarettes), and nonsmoker (an individual who has never smoked or has smoked no more than 100 cigarettes).[14]

Stage of behavior change, ie, level of readiness to quit smoking, was assessed using the following stages: (1) pre-contemplation stage with no interest to quit (ie, an individual who is not interested in quitting), (2) pre-contemplation stage with an interest to quit or contemplation stage (an individual who is interested in quitting but is not ready to do so within 1 month), and (3) preparation stage (ie, an individual who is ready to quit smoking within 1 month).[15,16] The level of nicotine dependence was estimated on the basis of the Tobacco Dependence Screener (TDS), which comprises 10 questions.[17] Smokers with a TDS score of 5 or higher were defined as being nicotine-dependent.

Dentists were questioned about their smoking status and their attitude regarding the effects of smoking on their patients. Their smoking status was defined in the same manner as that described for patients. Their attitude toward the effects of smoking on their patients was assessed by their answers to the following questions: "Are you concerned about the effects of tobacco smoke on your patients' health?" and "What preventive measures against passive smoking do you implement in your offices?".

Analyses

For the patient data set, we calculated the prevalence of current smokers and 95% CIs for each sex and each of 6 age groups (20–29, 30–39, 40–49, 50–59, 60–69, and ≥70 years). The prevalence of current smoking among dental patients, according to sex and age group, was compared with that of the community, which was assessed during the National Health and Nutrition Examination Survey (NHNS) conducted in November 2007.[18] The distribution of stage of change and nicotine dependence among current smokers was compared among age groups within each sex. Smoking prevalence among dentists was calculated for each sex and age group. The prevalence of current smoking among male dentists in 2008 was compared with that among male physicians reported in 2000 and 2008.[19] The percentages of each answer to the questions regarding dentists' attitudes toward the effects of smoking on their patients were compared among current smokers, former smokers, and nonsmokers. Crosstab procedures were performed using statistical software (PASW Statistics 18, IBM Corporation, NY). The Z and chi-square tests were used to determine statistical significance. The significance level was set at P less than 0.05.

Table 1. Sex and age distribution of dental patients

	Category	*n*	%
Sex	Males	4853	42.7
	Females	6517	57.3
Age group (years)	20–29	1063	9.3
	30–39	1531	13.5
	40–49	1528	13.4
	50–59	2147	18.9
	60–69	2632	23.1
	≥70	2469	21.7
Total		11370	100.0

Table 2. Sex and age distribution of dentists

	Category	*n*	%
Sex	Males	680	92.0
	Females	59	8.0
Age group (years)	20–29	2	0.3
	30–39	82	11.1
	40–49	253	34.2
	50–59	272	36.8
	60–69	118	16.0
	≥70	12	1.6
Total		739	100.0

Table 3. Comparison of the prevalence of current smoking in dental patients and the population in a national survey[a]

Sex	Age group (years)	Dental patients		Population of survey[a] %	*P* value[b]
		n	% (95% CI)		
Males	20–29	186/366	50.8 (45.7–55.9)	47.5	0.226
	30–39	334/585	57.1 (53.1–61.1)	55.6	0.490
	40–49	337/628	53.7 (49.8–57.6)	49.1	0.023
	50–59	449/907	49.5 (46.2–52.8)	42.3	<0.001
	60–69	422/1211	34.8 (32.1–37.5)	32.8	0.147
	≥70	234/1156	20.2 (17.9–22.5)	18.6	0.174
	All	1962/4853	40.4 (39.0–41.8)	39.4	
Females	20–29	175/697	25.1 (21.9–28.3)	16.7	<0.001
	30–39	202/946	21.4 (18.8–24.0)	17.2	0.001
	40–49	173/900	19.2 (16.6–21.8)	17.9	0.332
	50–59	173/1240	14.0 (12.1–15.9)	9.3	<0.001
	60–69	121/1421	8.5 (7.0–10.0)	7.3	0.091
	≥70	52/1313	4.0 (2.9–5.1)	3.7	0.617
	All	896/6517	13.7 (12.9–14.5)	11.0	
Total		2858/11370	25.1 (24.3–25.9)	24.1	

[a]National Health and Nutrition Survey, 2007.[18]
[b]Z-test for proportion.

RESULTS

Among 1022 dental clinics, 799 responded to the survey (a response rate of 78.2%): 753 (73.7%) to the patient survey, 763 (74.7%) to the dentist survey, and 717 (70.2%) to both surveys. Of the collected data for 14187 patients obtained from 753 dentists, information from 2817 (20%) was excluded because of incomplete responses: 4% for the item on smoking status and 16% for other items. Data for the remaining 11370 patients were then analyzed (Table 1). The mean number of patients per clinic was 15.7 (SD = 7.6). Of the 763 dentists who responded to the dentist survey, 24 were excluded because of lack of information on smoking status. The remaining data for 739 dentists were analyzed. Analysis of the sex and age distributions revealed that males were predominant (92% males and 8% females) and that very few dentists were aged 20 to 29 years or 70 years or older (Table 2).

Table 3 compares the prevalence of current smoking among dental patients and the NHNS population. The overall smoking prevalence among dental patients was 25.1% (40.4% in men and 13.7% in women), which was similar to that of the NHNS population (24.1%). The prevalences of current smoking among male patients aged 40 to 49 and 50 to 59 years were higher than that reported for the NHNS population ($P = 0.023$ and <0.001, respectively). Among female dental patients, the prevalences of current smoking in the age groups of 20 to 29, 30 to 39, and 50 to 59 years were significantly higher than that reported in the NHNS population ($P < 0.001$, 0.001, and <0.001, respectively).

Table 4 shows the distribution of stage of behavior change and nicotine dependence among patients who currently smoked. The distributions of stage of behavior change and nicotine dependence differed by sex and age group. The overall distribution was 25.8% in pre-contemplation lacking interest to quit, 66.4% in pre-contemplation with interest to quit or contemplation, and 7.8% in the preparation stage. As compared with men, women had a higher level of readiness to quit smoking ($P < 0.001$). Among men, those aged 60 years or